Forward Proton Detector Status

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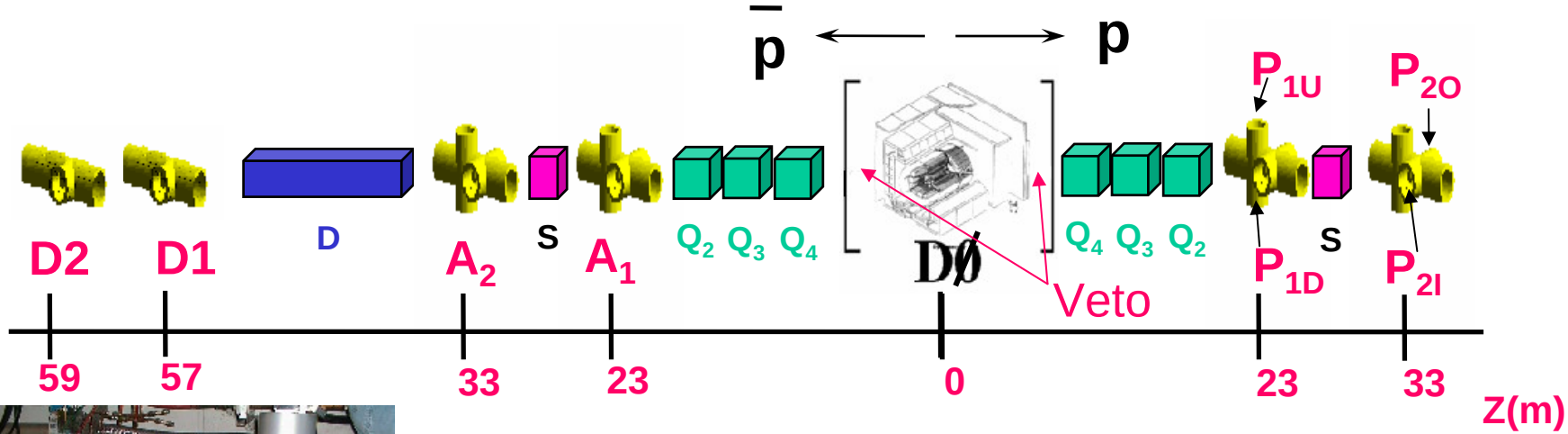
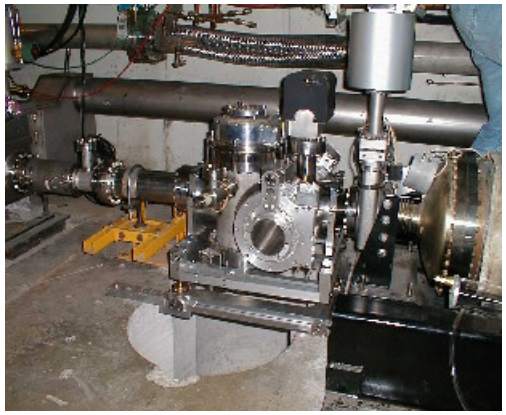
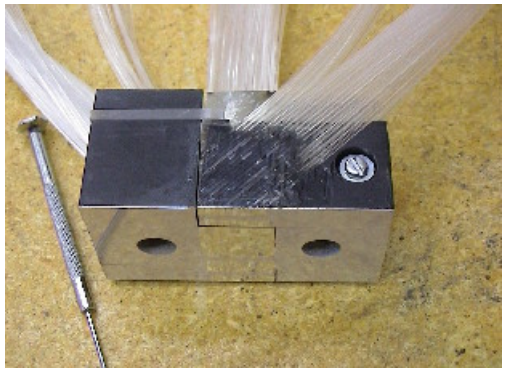
Forward Proton Detector Layout







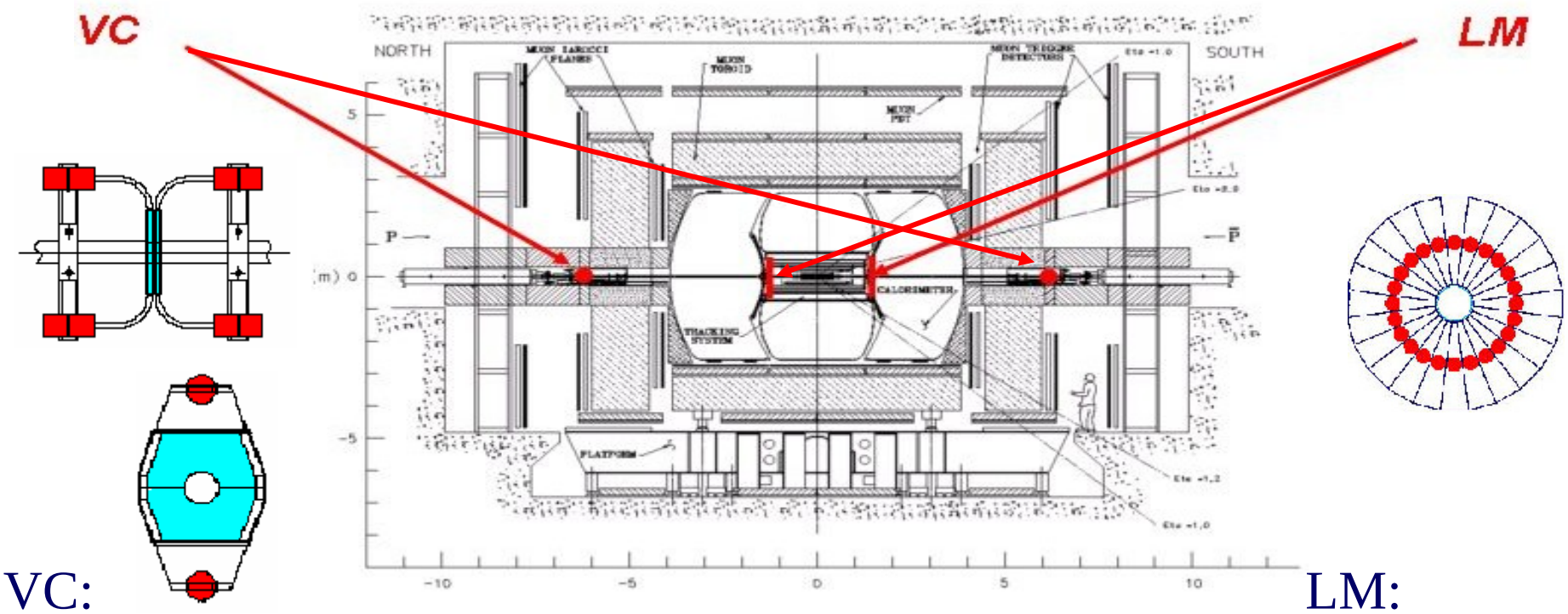
- 9 momentum spectrometers composed of 18 Roman Pots
- Scintillating fiber detectors can be brought close (~6 mm) to the beam to track scattered protons and anti-protons
- Reconstructed track is used to calculate momentum fraction and scattering angle
  - Much better resolution than available with gaps alone
- Cover a t region ($0 < t < 3$ GeV^2) never before explored at Tevatron energies
- Allows combination of tracks with high-p_T scattering in the central detector

Diffractive Topics

Student Year	Institute	Advisor	Subject
Tamsin Edwards 2005	Manchester	B. Cox	Diffractive Z production using gaps
Ana Carolina de Jesus 2007	Rio	A. Santoro	Heavy Flavor production in diffraction
Helena Malbouisson 2007	Rio	A. Santoro	Diffractive dijet structure function
Miguel Mendoza 2007	Bogotá	C. Avila	Diffractive W, Z
James Monk 2006	Manchester	B. Cox	Double Pomeron
Renata Rodrigues 2007	Rio	A. Santoro	Diffractive jets (double Pomeron)
Michael Strang 2004?	UTA	A. Brandt	Diffractive jets tagged with FPD

New student, Roman Otec, working on diffractive jets

Rapidity Gap System Run II



VC:

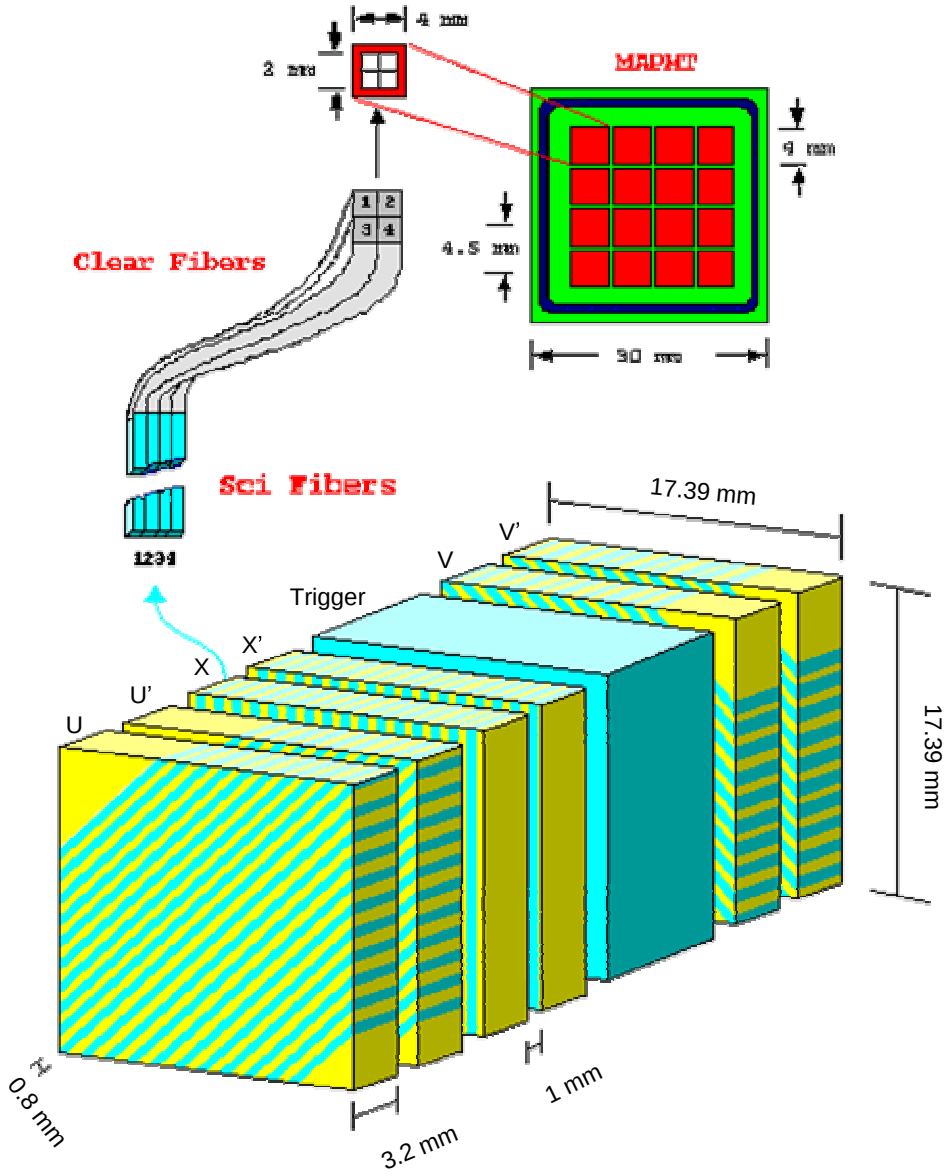
$5.2 < \eta < 5.9$

LM:

$2.5 < \eta < 4.4$

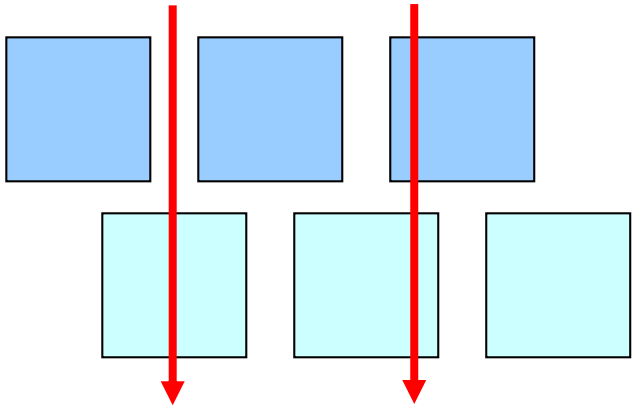
- Currently vetoing on Luminosity Monitor for rapidity gap triggers
- Future:
  - Can add Veto Counters to Level 1 Trigger
  - Use calorimeter at Level 2 to further refine rapidity gaps

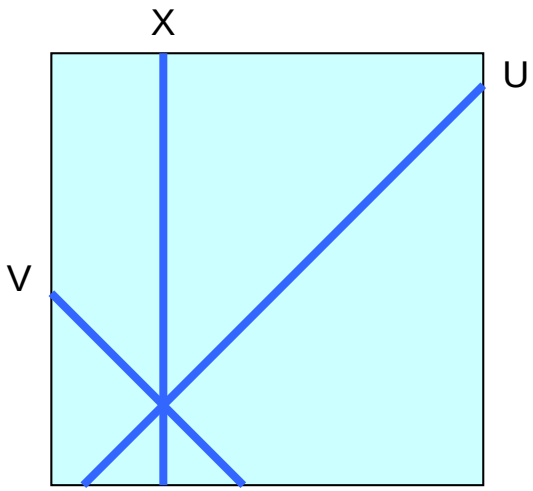
FPD Detector Setup



- 6 layers per detector in 3 planes and a trigger scintillator
- U and V at 45 degrees to X, 90 degrees to each other
- U and V planes have 20 fibers, X planes have 16 fibers
- Layers in a plane offset by ~2/3 fiber
- Each channel filled with four fibers
- 2 detectors in a spectrometer

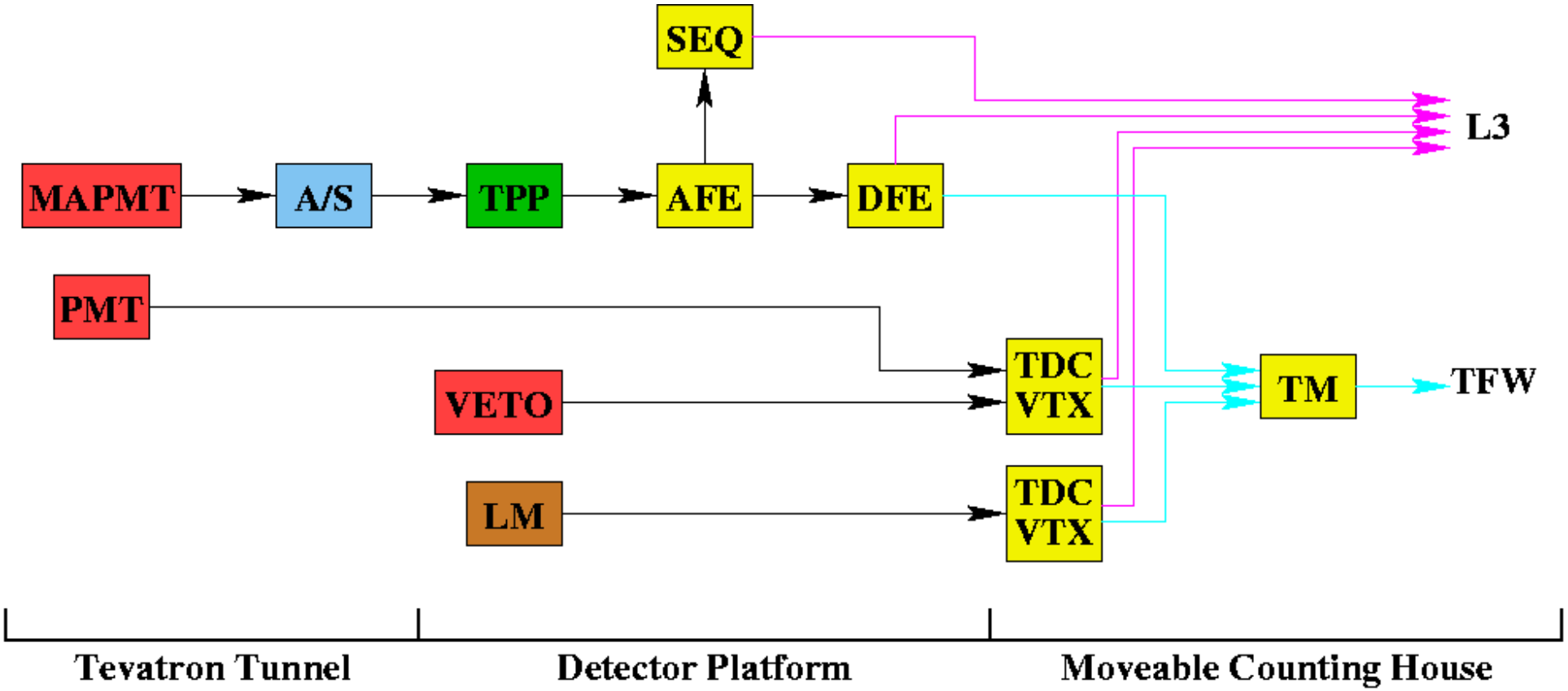
Segments to Hits





- Combination of fibers in a plane determine a segment
- Need two out of three possible segments to get a hit
  - U/V, U/X, X/V (or U/X/V)
    - Can reconstruct an x and y
- Can also get an x directly from the x segment
- Require a hit in both detectors of spectrometer

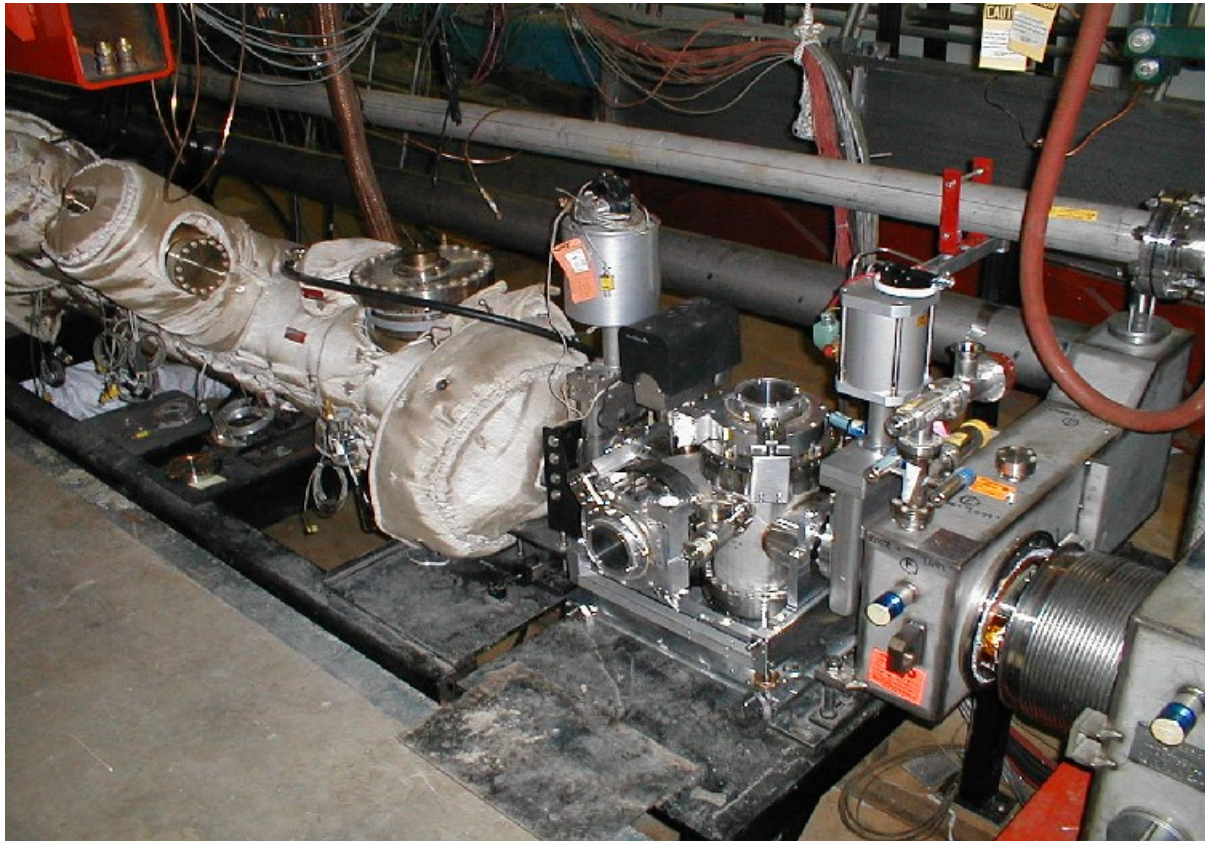
FPD DAQ


SEQ
L3
MAPMT
A/S
TPP
AFE
DFE
PMT
TDC
VTX
TM
TFW
VETO
LM
TDC
VTX
Tevatron Tunnel
Detector Platform
Moveable Counting House

Castle Status

- All 6 castles with 18 Roman pots comprising the FPD were constructed in Brazil, installed in the Tevatron in fall of 2000, and have been functioning as designed.

- All castles were checked and underwent maintenance during Fall 2003 shutdown



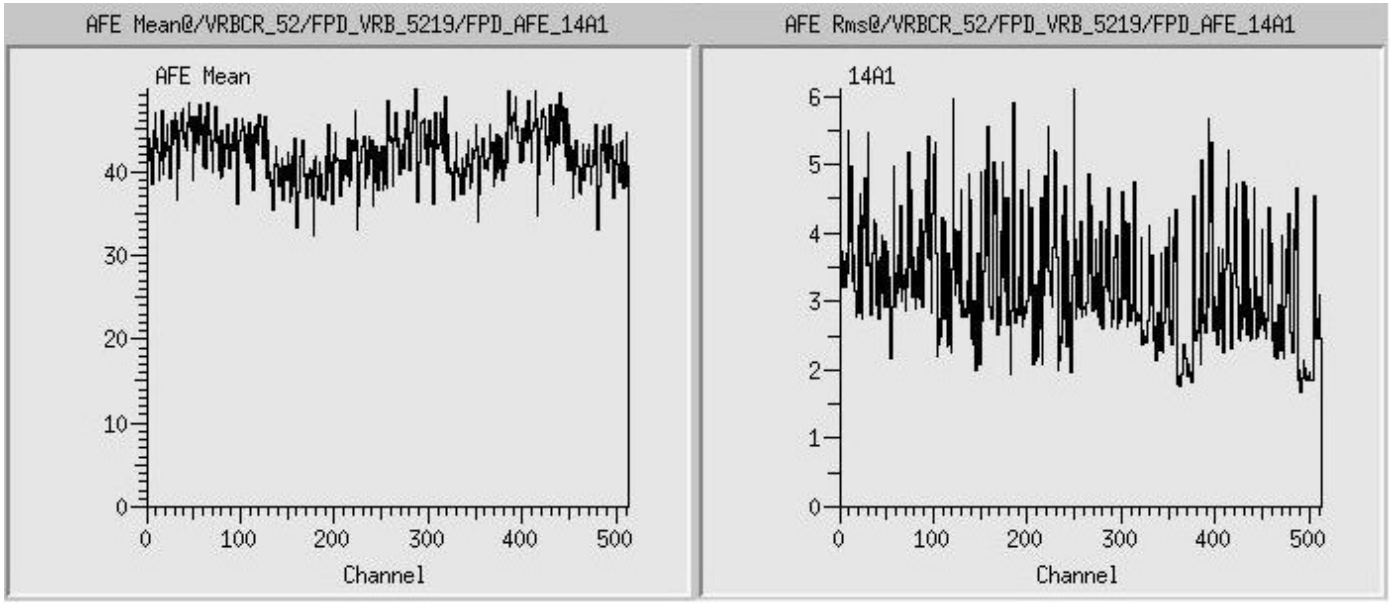
A1 Quadrupole castle installed in the beam line.

Detector Status

- In 2001-2002, 10 of the 18 Roman pots were instrumented with detectors.
- Funds to add detectors to the remainder of the pots was obtained from NSF (mostly for MAPMTs)
- During the shutdown the final eight detectors and associated readout electronics were installed. Dark current was verified with detectors in place.
- Shielding was installed because of high rates seen before shutdown
- Low Voltage Power Supplies were upgraded, installed and tested under full load

A2 Quadrupole castle with all four detectors installed

Resolution of TPP Noise Problem



- Transition Patch Panel is used to interface between ribbon cable carrying signal from the tunnel and flex cable for the AFE
- Before Shutdown, we saw rms values near 20 (4 or 5 is typical for AFE board) traced to a capacitive coupling on the board
- Redesigned and replaced all (18) boards during the shutdown
- After shutdown, rms values are near 4 or 5

Operations

- FPD expert shifters inserting pots and Captains removing pots and setting system to standby
  - Went through extensive review of operations and safety as result of quench caused by CDF pots
  - Have been training new experts, now have 7, 2 more to train
- 18 pots inserted every store
- Have been occasional problems that have been repaired in short accesses
- Eventually, combine shifts with CFT, since similar readout system
- Working towards automated pot insertion by Captain
  - Wanda Prado arriving next week to start implementing
- Working towards adding entry on big display of control room indicating status of FPD system:

  FPD running (pots in/HV on) / FPD standby (pots home/HV off)

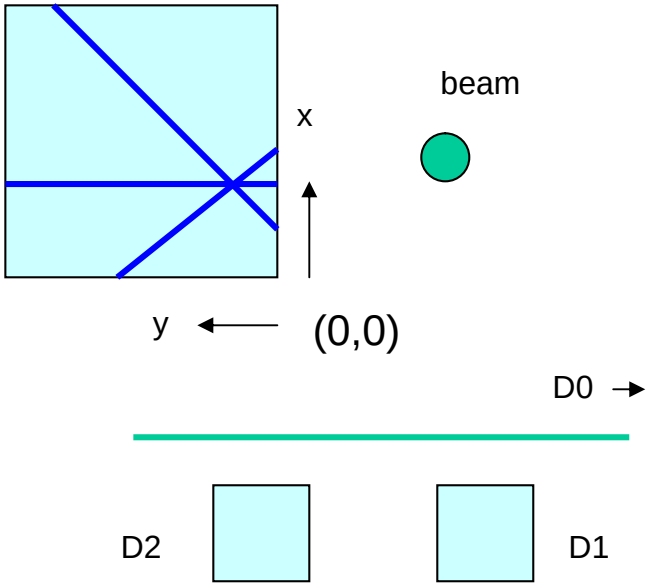
Data Quality

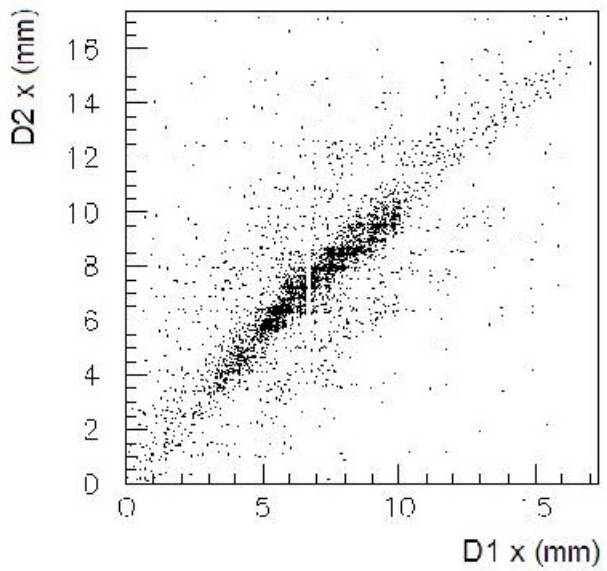
- A Brazilian student (Renata Rodriguez) is working on creating a standard FPD examine to monitor data as it is being collected (currently using hacked version of CTE examine)

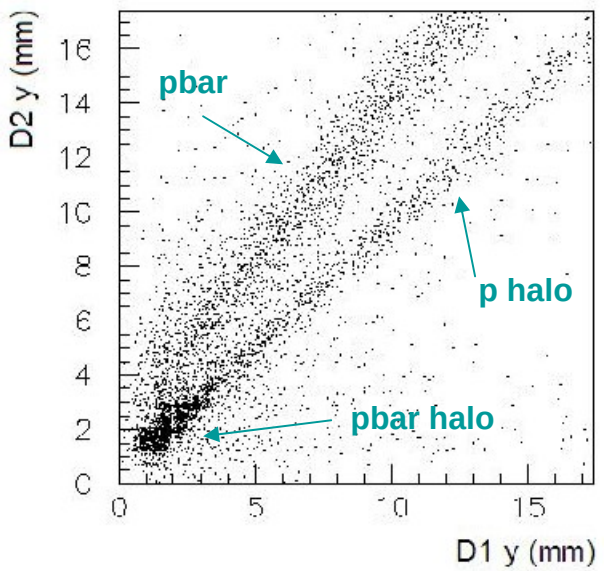
- Data Taskforce in Brazil being implemented to regularly look at data and database and determine data quality of each run for FPD data and commission new detectors
  - This has proceeded slowly for a variety of reasons, but thanks to new Fermilab funds for Brazilian visitors is expected to proceed expeditiously (Gilvan Alves, currently at Fermilab will be coordinating this effort, replacing Luiz Mundim who will be arriving Apr 1 to help with lum database)

- We will be having an FPD data analysis workshop in Rio Mar 29-30

Standalone FERA Dipole Data

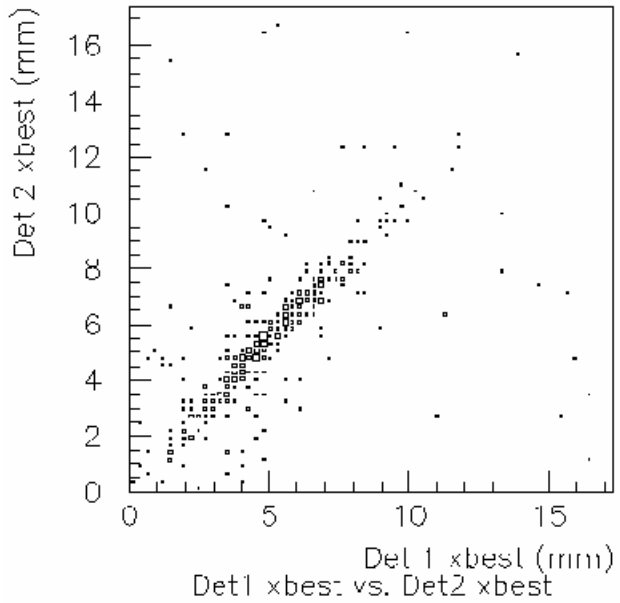


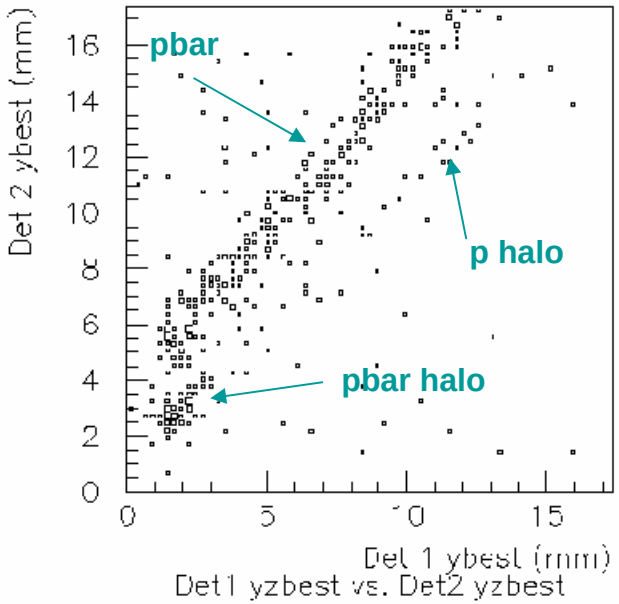




- Triggered on coincidence in trigger scintillators between detectors. Apply harsh multiplicity cuts to try to see cleanest tracks.
- See correlations in hit location between both detectors in same event indicating a single particle passing through both detectors (higher band on right plot), spread out over x
- Halo particles displaced from the beam, traveling with beam momentum hit at the same y in both detector (lower band on right plot), spread out over x
  - Excess of events at low y seem to be pbar halo as they remain after a TDC cut removing events that hit in D2 before D1 remove the rest of the lower correlation
- Diffracted pbars that have lost a few percent of their momentum are bent inwards by the dipole magnets so that they travel at an angle between D1 and D2 giving a higher y value in D2 than D1.

Pre-shutdown AFE Dipole Data



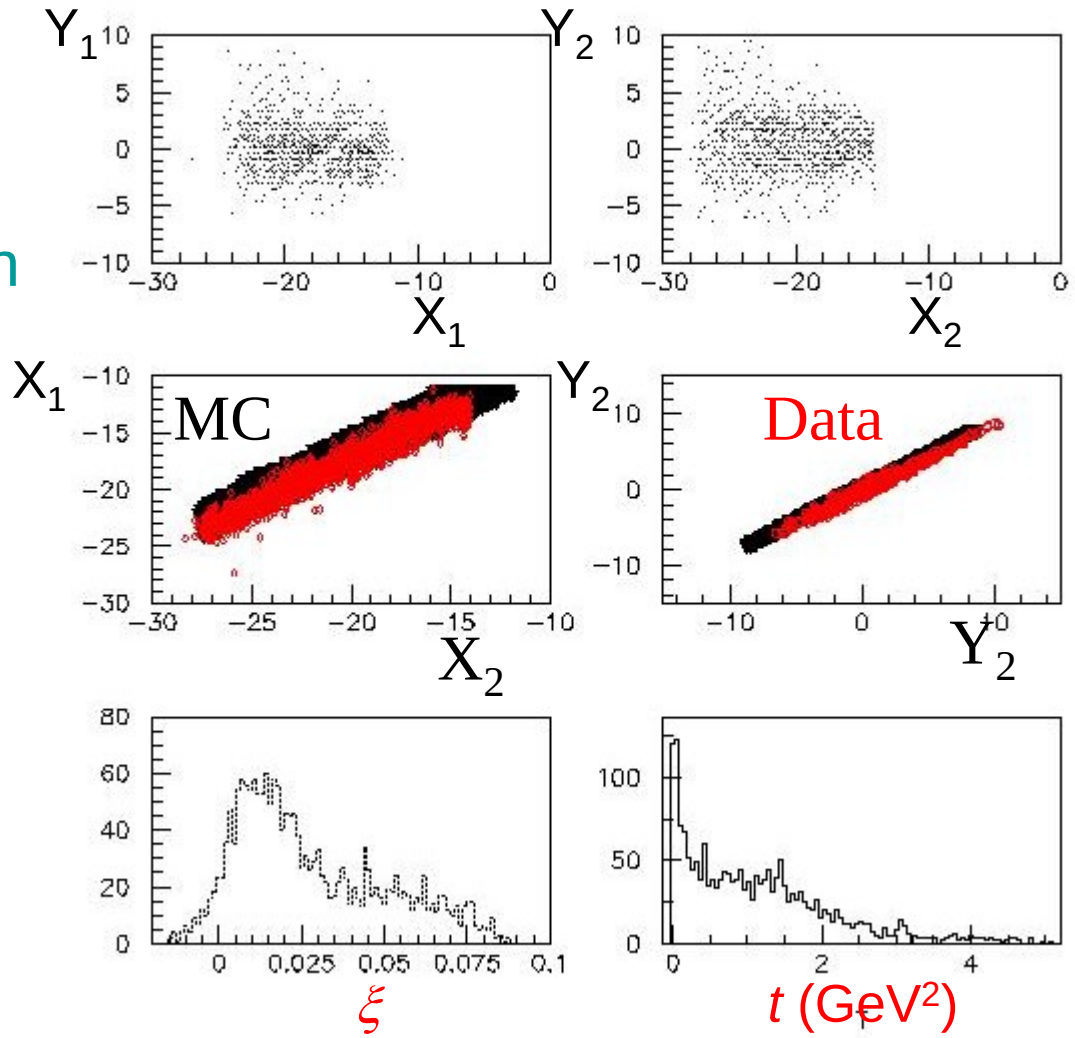


- Uses trigger JT_25TT_GapN:
  - one jet with 25GeV and North luminosity counters not firing
- Similar correlations to standalone
- Jet requirement suppresses proton halo, or clean beam conditions
- This is only a small sample

Dipole Diffraction Results

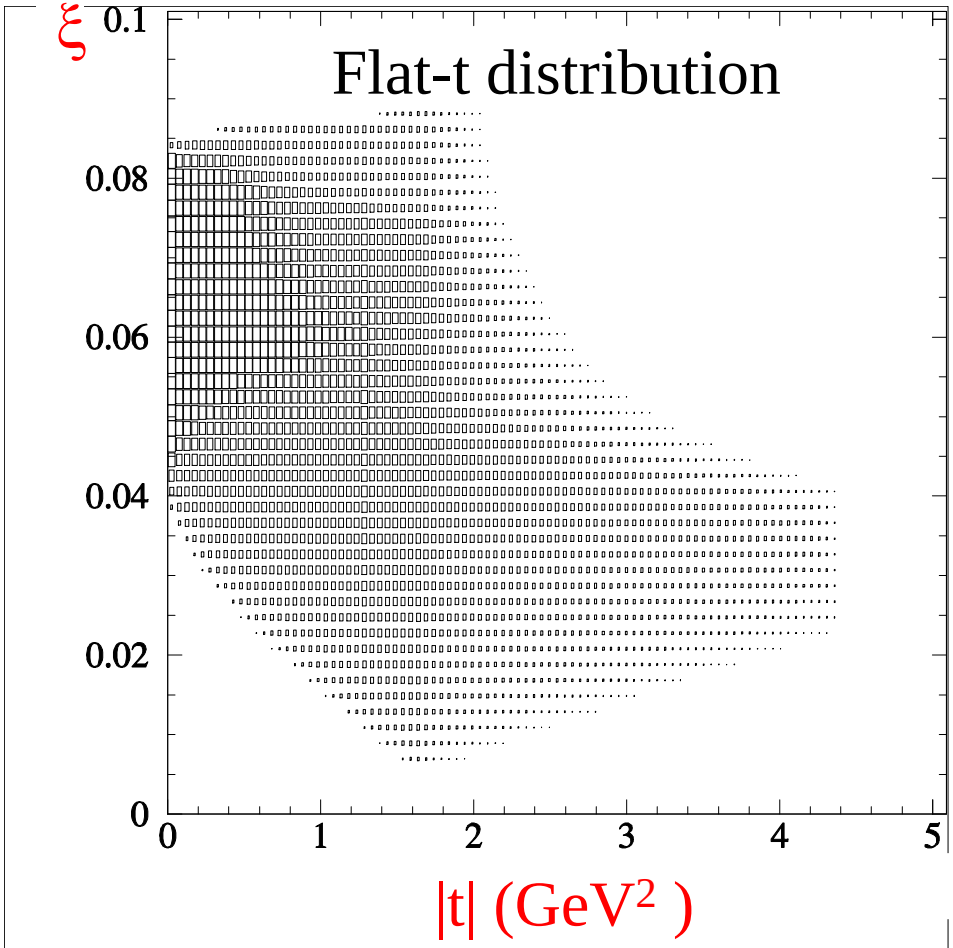
All units in mm

- Alignment corrections applied
- Fair agreement between MC and Data
- Reasonable ξ and t distributions
- Allow us to study ξ vs t correlation

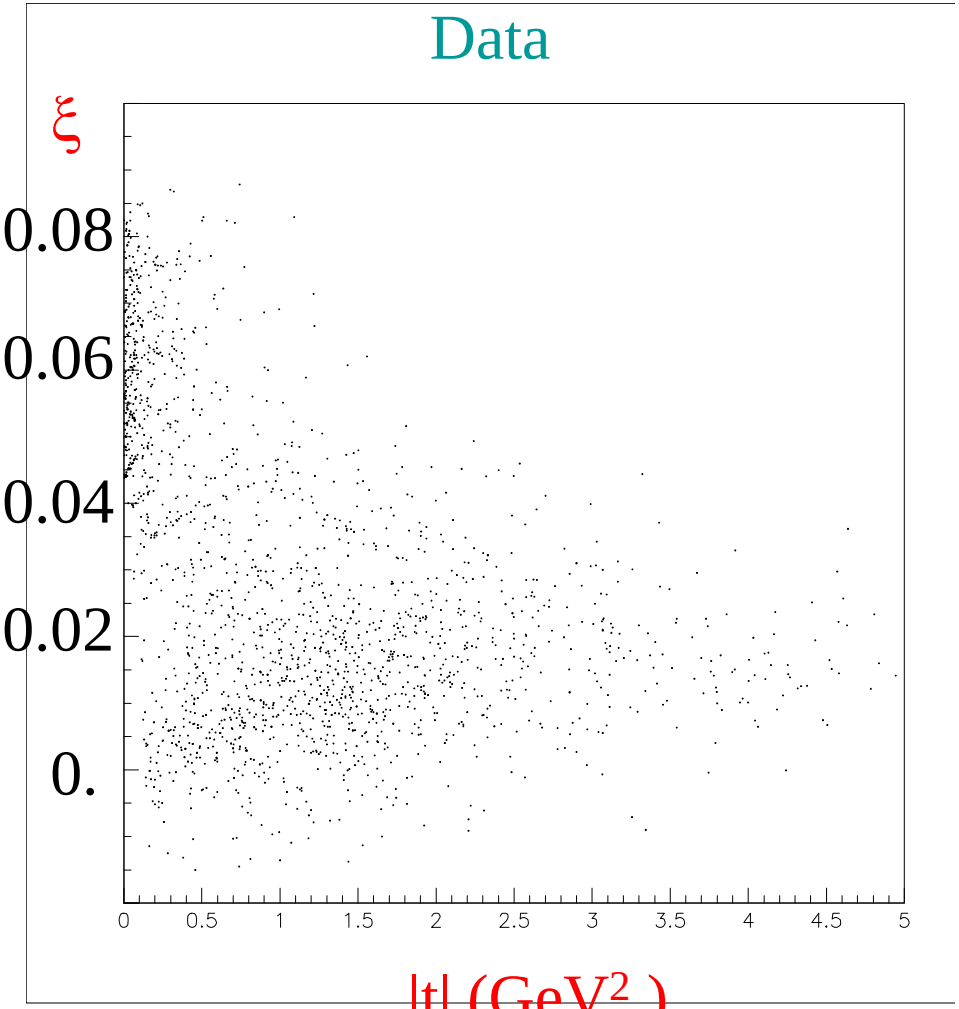


Dipole Diffraction Acceptance

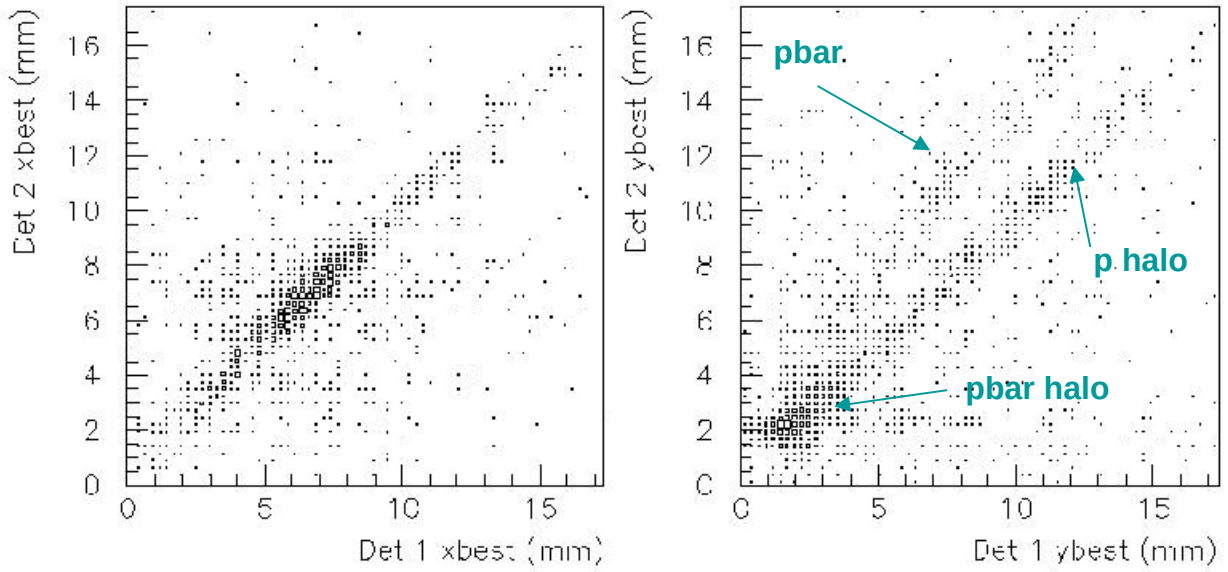
Geometrical Acceptance
14σ



Data

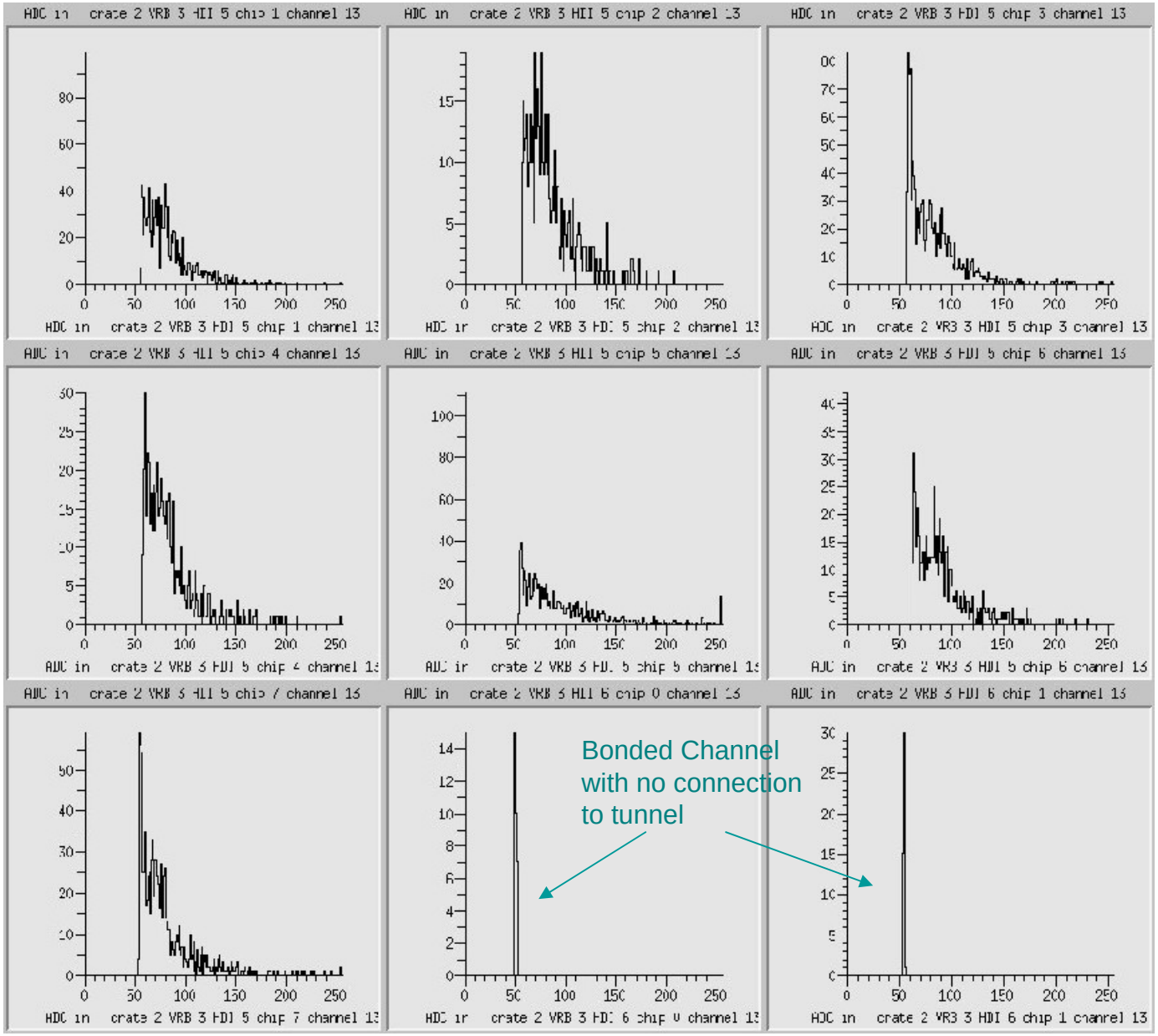


Post Shutdown AFE Dipole Data



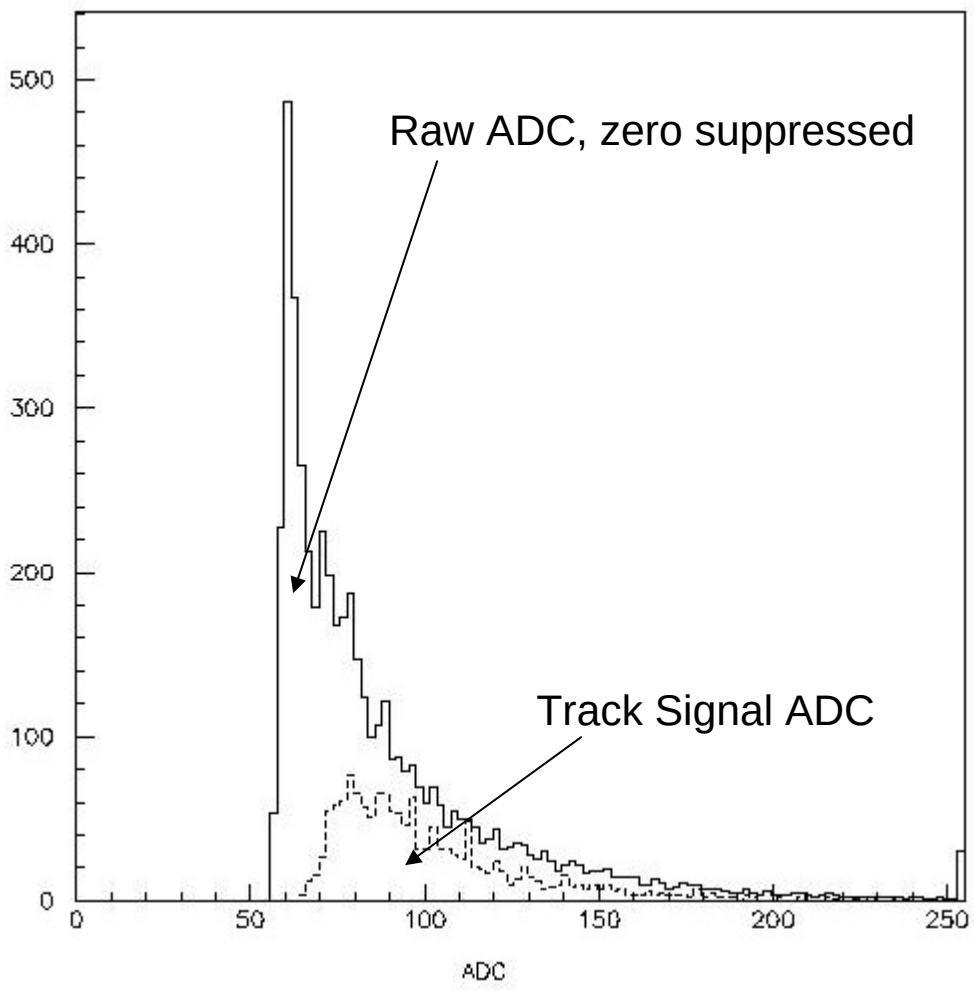
- Uses JT_15TT_GapN and JT_45TT_GapN Triggers
- Data from store 3189 – 3206 (late January)
- Beam conditions are different (higher luminosity)
- Timing isn't fully optimized but using best theoretical value

Sample ADC plots (A2 and P2 Horizontal)

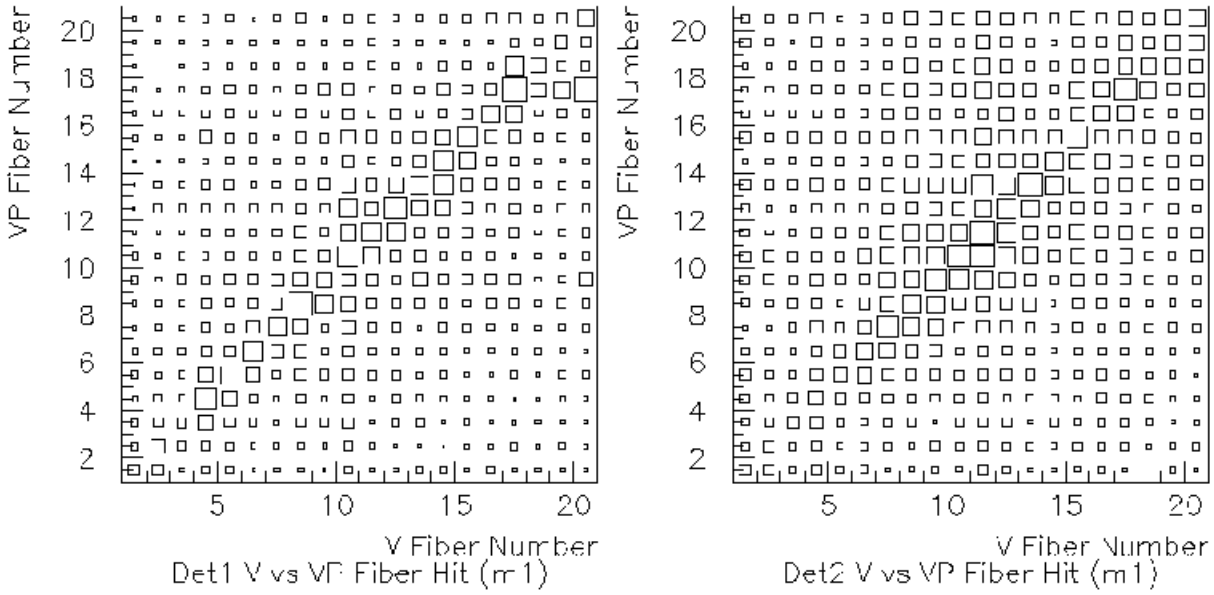


Dipole ADC distributions

- Raw is normalized by 5000 (~39,000 raw events vs. ~1500 signal events)
- Both are the sum of 6 channels (for statistics reasons)
  - X(4) through X(9)
- Mean of signal is ~83
- Mean of ped is ~44
- Rms of ped is ~4
- Significance of signal ~9



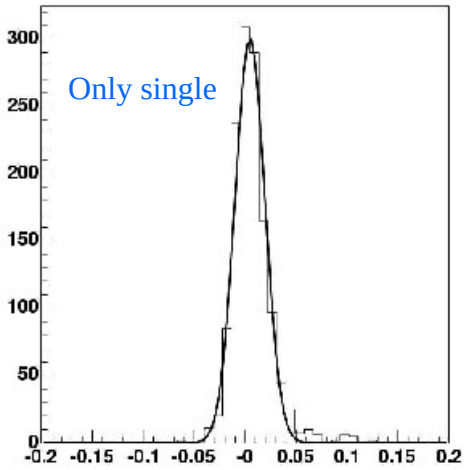
Post Shutdown Quadrupole Data



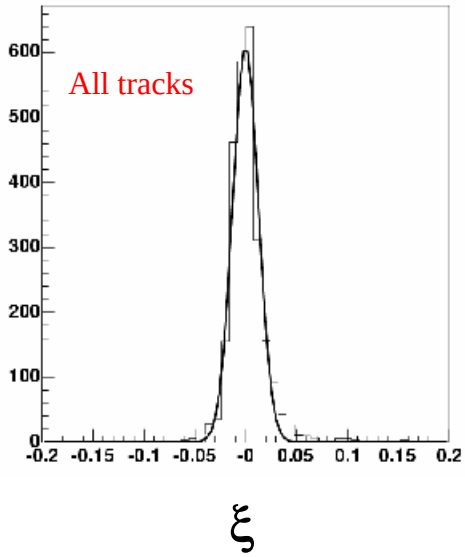
- Looking for particles passing through detectors
- Expect to see correlation between fibers when comparing layers of the same plane (above is P1D and P2D for store 3191)
- Need more experience with quadrupole diffractive data. Hit correlation studies are better done with elastic triggers for quadrupole detectors.

Multi-hit Studies

- Performed on standalone elastic data
- Loosen harsh multiplicity cuts in each detector to increase chance of finding tracks between detectors
  - Allow 3 segments per plane (optimized between increased efficiency and increased processing time)
- This approximately doubles the number of tracks in the samples



	Value	Error
Constant	3.01e+2	1.153e+1
Mean	4.672e-3	4.577e-4
Sigma	1.469e-2	3.793e-4



	Value	Error
Constant	6.103e+2	1.755e+1
Mean	-1.238e-4	2.761e-4
Sigma	1.262e-2	2.561e-4

FPD Conclusions

- Full 18 detector system in readout
- Software in place and tested, FPD included in all DØ events
- FPD_LM TDC boards installed, being commissioned by Manchester group (Brian Cox, James Monk, Scott Kolya, Dave Mercer); Vertex board being commissioned by Brendan
- DFE boards complete, firmware has been implemented and is being tested. Thresholds to be tuned with new AFE/TPP setup
- Trigger manager commissioning in progress, first triggers using DFE expected in March (Mario Vaz, Daniel Mendoza)
- NIM/CAMAC trigger still in place for special runs